flavescens, its American analogue, at least here in southern California. Mistletoe is very abundant, and at the proper season one may find seeds glued on branches of trees, on fences and stones, in short, wherever birds alight. I have never seen any that had the appearance of having passed through the digestive tract of a bird. They seemed rather as if left by the bird in cleaning his bill or feet, to which they may have adhered while he was feeding. This is more probable from the fact that seldom do more than two or three seeds appear to have been deposited at one time. Young mistletoes usually, but not always, start from the upper half of the branch on which they grow.

Why *P. flavescens* should be leafy and *P. juniperinum* leafless, has been plausibly explained from the fact that the first species, growing on deciduous trees, needs leaves of its own during the resting period of its host, while the juniper mistletoe needs none since it grows on evergreens. This is a satisfactory explanation, but it evidently needs amendment to make it clear why *P. Bolleanum*, growing on junipers, should be leafy, while *P. Californicum*, which is parasitic on the mesquite and other deciduous hosts, is leafless.

San Bernardino, California.

REVIEWS

The Comparative Embryology of the Rubiaceae *

The second part of Professor Lloyd's study has recently appeared and forms a very valuable as well as interesting contribution to our knowledge of the Rubiaceae. In this paper there are studies of the following species: *Callipeltis Cucullaria*, *Sherardia arvensis*; several species of *Galium*, viz., *Aparine*, *recurvum*, *pilosum*, *Mollugo*, *verum*, *triflorum*, *tinctorum* and *Parisiense*; several species of *Asperula—azurea*, *galioides*, *montana*, *setosa*, and *tinctoria*; *Rubia tinctoria*; *Crucianella gilanica*, *C. macrostachya*, *C. herbacea*; *Diodia Virginiana*, and *D. teres*; *Richardsonia pilosa*; and *Houstonia coerulea* and *H. longifolia*.

* Memoirs of the Torrey Botanical Club, 8: 27–112. *pl.* 5–15. 15 F. 1902.

Since it is hardly possible in a short review to present in detail the results of this throughgoing study, I shall summarize only what are apparently the most important conclusions.

In all of the plants studied except *Houstonia* two ovules and one integument are present ; *Houstonia* has many ovules and no integument, realizing the " nucellus nudus " of Schleiden. In the Spermacoceae, there is, in addition to the integument, an outgrowth which contains the vascular supply of the ovules and is the seat of a large number of excretory cells. This is termed the strophiole.

The archesporium, except in the Spermacoceae and Oldenlandeae, contains 7–15 macrospore mother-cells, and each macrospore mother-cell divides twice to form four spores, which are physiologically and morphologically equivalent, and any or all of which may undergo one division although the functional embryo-sac is derived from the middlemost of the group. In the Spermacoceae and Oldenlandeae there is but one macrospore mother-cell.

The embryo-sac presents some curious and interesting deviations from the usual conditions that obtain in the higher plants. The embryo-sac either develops where the macrospore is formed (*Houstonia* and *Richardsonia*), or it moves along the micropylar canal, and in extreme cases (as in *Asperula*) the mature embryo-sac may partly protrude from the end of the canal and come to lie between the integument and the pericarp.

As regards the antipodals, although invariably present, they vary greatly both as to function and number. Perhaps the most interesting of the antipodals described are those of *Callipeltis Cucullaria*, of which one is greatly elongated and acts as a haustorium, by the action of which the supernumerary macrospores are destroyed and their contents ingested and made available as food for the developing embryo-sac.

The young embryos of the Galieae are provided with haustorial outgrowths that project laterally from the suspensor. Their function as absorbers ceases as soon as the adjacent endosperm cells become filled with reserve food, and their walls become thickened to form a reserve cellulose.

An account is given (pp. 66–88) of the mitoses of the archesporium and embryo-sac, based mainly on a study of *Asperula montana*, *Crucianella macrostachya* and *C. gilanica*. The embryo-sac mother-cell contains a large number of coarse fibers which persist through the prophases of the first division and are regarded as currents of kinoplasm and not, therefore, as a rearrangement of the reticulum. As in the higher plants, the spindle is of multipolar origin, no centrosomes are present, and the maturation divisions are normal. In *Crucianella* the interesting discovery of ten as the reduced number of chromosomes was made.

The behavior of the pollen tube in *Diodia* and *Richardsonia* is given in much detail. After leaving the pistil the tube may make its way either between and in a direction at right angles to the columnar epidermal cells that are in the neighborhood of the micropyle (*Richardsonia pilosa* and *Diodia teres*), or, it may extend to the surface of the ovule and travel upon it to the micropyle (*Diodia Virginiana*). Professor Lloyd concludes that chemotropism is the important factor in determining the later direction of growth of the pollen tube, that the distribution of the irritant is a differential one, and, finally, he suggests that the synergidae or possibly the ovum may be the source of the stimulant. The pollen tube does not as a rule act unfavorably on the cells with which it comes into contact except in so far as injury may arise from the pressure that it may exert upon them.—W. A. Cannon.

A University Text-book of Botany*

With nearly 400 pages devoted to the botanical system out of a total of 550, the present work would seem to represent a work on systematic botany and it must be interpreted mainly from that standpoint, although it is written by one who has never been classed as a systematic botanist. The work as a text-book must most naturally be compared or contrasted with the most recent emanation from the Germans familiarly known in our laboratories as the "Bonn text-book," for it is evidently this work that the

*A University Text-Book of Botany, by Douglas Houghton Campbell, Ph.D. xv + 579 pp. *Pl. 1–15* + *f. 1–193*. New York, Macmillan & Co. (Price, $4.00.)